The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. LI
No. 1327

SATURDAY, DECEMBER 2, 1944
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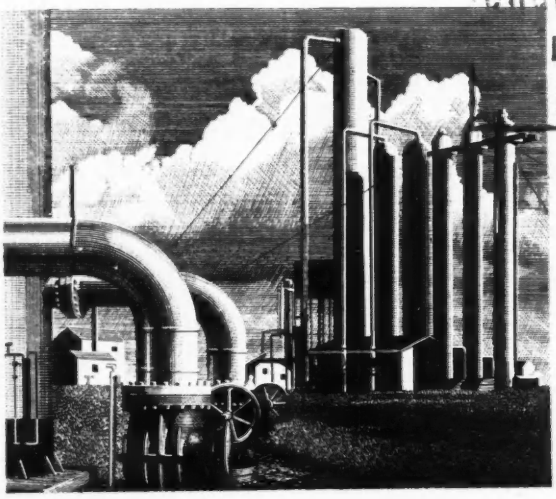

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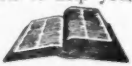

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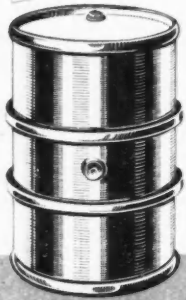

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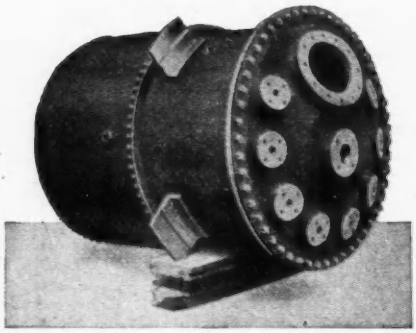

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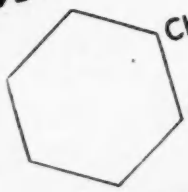

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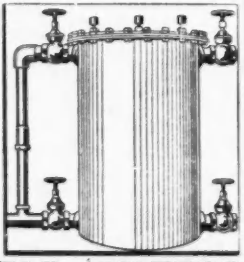

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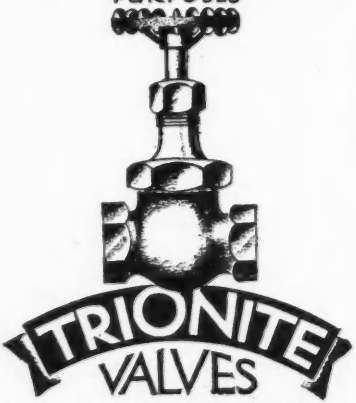

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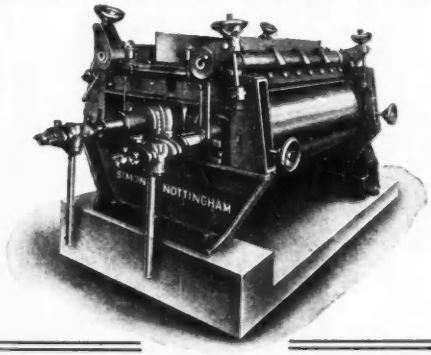

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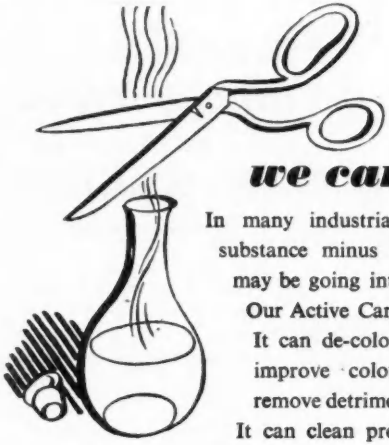

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VOL. LI
No. 1327.

December 2, 1944

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Standards of Efficiency

WE have laid emphasis, in recent leading articles, on the importance of industrial efficiency. Since Britain will have to make her way in a competitive world, and will consequently be dependent upon the success of her industry, the problem of industrial efficiency is one of the first magnitude. We should, however, pause to ask what we mean by efficiency and how we are to measure it.

The practice of comparing the efficiency of different works has been the cause of much heart-burning and not a little injustice in the past. Directors, under the mistaken belief that their managers and staffs would only give of their best if a rod were kept in pickle for them, have been prone to compare the several works, or departments of one works, under their control one with another on the basis of technical results, irrespective of the nature of the raw materials utilised, of the plant in use and of other local considerations. We remember more than 40 years ago a works manager reduced almost to tears and certainly to obscenity after a meeting with his managing director in which the managing director had pointed out that the yields of sulphate of ammonia from a coke-oven plant in South Yorkshire were distinctly greater than the yields from a plant operated by this particular manager in Cumberland, and the comparison was persisted in irrespective of the fact that the coals used in the two plants were quite different in character and one works was much older than the other. Before being able to compare the results of different managements we must lay down standards of efficiency and discover methods by which the results of different firms can be compared, due regard being paid to local conditions and local difficulties.

A fourth edition of a book by Mr. T. G. Rose, formerly works manager of Leyland Motors, has just been published under the title *Higher Control in Management*. The principle underlying this "higher control" is that everything that occurs in an undertaking can be isolated under one or other of four heads—the business position, the technical position, the trading position, and the financial position. The motive, however, is not simply to record under these heads whatever may have occurred within the precise limits of a particular period—that is the function of the accountant: it is rather to show the

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divergencies from the normal month by month, so that responsibility for success or failure can be assigned in the right quarter. The method uses the ordinary accounting figures and re-arranges them from a current management standpoint. In the chapter on the financial position, for example, various ratios are employed, such as the ratios of liquid assets to current liabilities, of the moving annual total of the turnover of sales to accounts outstanding and to stocks and work-in-progress, of the net worth of the business (*i.e.*, the surplus of total assets) to fixed assets, and the like, in order to expose the main flaws likely to be found in any balance-sheet structure. There are still many problems of correct interpretation and comparison to be solved before these methods, which managers are evolving to enable them the better to manage their own businesses, are likely to allow the relative efficiencies of different businesses to be measured, at any rate by those not running them; but the line of development has been set.

Management is at the same time an art and a science. Mr. Rose's approach is primarily from the scientific side of management and he has done valuable work in laying down some principles for this science, but it must be understood that management cannot be reduced to figures in the same way as a technical process can be. There is no substitute for those qualities of imagination, insight, enterprise, and human sympathy which are part of the total qualification for leadership. The management of plant and machinery can be delegated to men who are themselves little more than technical machines capable of operating a slide-rule or making deductions from a chemical analysis. The art of managing men lies in captaining the side so that every individual in it believes his own effort is of importance, and in such a way that everyone has and retains a keen interest in his job. It is good that out of the checks and tests now being developed entirely for purposes of control something approaching a standard or a series of standards of efficiency will eventually emerge. But the factors that add up to a high score judged by this standard will very often be imponderable and will be the result of the human qualities of the manager rather than of the technical efficiency with which he governs his works.

The importance of this matter of leadership cannot well be over-rated, whether in the business world, in the research laboratory, or indeed in any tribal activity that mankind pursues. To put the matter from another angle, one may reflect that there are few leaders, but there are many who will do first-class work if they can find someone to direct them. Thus we may quote the opinion of Carlyle: "Surely of all the 'rights of man,' this right of the ignorant man to be guided by the wiser, to be, gently or forcibly, held in the true course by him, is the indisputablest." Carlyle no doubt wrote as a political observer, but it is by no means only the "ignorant" who require leadership if they are to give of their best. But because there are many different types and grades of leader, a yardstick for the performance of the leader is as necessary as one for the performance of the led.

NOTES AND COMMENTS

National Achievement

ONLY last week we were advising the chemists of Britain that it would do no harm if they would blow their own trumpet occasionally. So we are specially pleased to see that this policy has obtained, as it were, official sanction. The publication of the Government's White Paper on Britain's war effort is indeed a record of superlative achievement, but it is inevitable that, as yet, it should be an incomplete record. Exactly what part the chemical industries have played in building the edifice cannot be fully revealed till our present task is accomplished, but we know it is no mean share, as statistics will show in time. What we are anxious to ensure is that the huge effort here displayed shall not be dissipated as soon as the war is over. To-day, we have to toil and sweat, and even to die, in order that our country and our civilisation may live. The danger is urgent and obvious; but there are other ways of killing a man besides shooting him. Slow strangula-

tion is even more unpleasant, and equally effective. The White Paper reveals that, despite all criticism, the effort made by all ranks to win the war has been magnificent. It is surely not too much to hope that some of the spirit now manifested will remain to inspire us in the less vivid, but not less vital, struggle which will face us in the hard days of peace that lie ahead.

A Dominion's War Effort

A GRAPHIC idea of the extraordinary expansion of the Canadian chemical industry since the outbreak of war is provided by a special number of the *C-I-L Oval* (1944, *13*, 3), the magazine of Canadian Industries Limited. The editor makes the comment that the task of those who have to record the detailed story of the Dominion's effort will be the work of a lifetime. The presentation of the facts to-day is limited by paper restriction and security considerations; yet the authors of the various chapters have made a brave showing. In some ways the situation faced by Canadian chemists was more difficult than our own, though in other directions there were compensating features. Full co-ordination was quickly established with the Dominion's powerful neighbour, and interchange of information and often of material between Canada and the United States often helped to solve an urgent problem. The supply of technical man-power was always a difficulty; it was necessary not only to keep the factories going, but also to provide technical staffs for the Services. When it is realised that Defence Industries Limited, the subsidiary company specially created to cope with war-time operations, started with a nucleus of 15 technical men from C.I.L. and the small TNT and cordite plants at Beloeil, Quebec, it goes without saying that quite a strenuous effort was needed to construct, equip, and man the present resources of Defence Industries Limited: three explosives plants; two chemical works; two S.A.A. works; a central tool shop; three filling plants; a fuse-assembly plant; and three storage magazines. These, it will be seen, are concerned merely with the strictly warlike products of the chemical industry. Metallurgy, also, and the chemistry of oil, rubber, food, glass, wood, and plastics—all have progressed to an astounding degree.

The Chemical Institute of Canada

MANY years have passed since it was first suggested that a single association should be formed in this country for the purpose of looking after the interests of all chemists; and many arguments have been cited for and against the proposal. We do not intend to go into the *pros* and *cons* of the matter here; but it is interesting to note that Canadian chemists have made the great decision for themselves, and that after January 1, 1945, they will be represented by one single institute—the Chemical Institute of Canada. On the same date the Canadian Chemical Association and the Canadian Institute of Chemistry will cease to function, while the Canadian Council of the Society of Chemical Industry has agreed to end at that time all activities which may conflict with those of the Chemical Institute. This co-ordinated state of affairs was not arrived at, it may be imagined, without much debate; but federation has been in the air for many years. War has been the catalyst that hastened the reaction, and in 1942 all members of the C.I.C. and C.C.A. were circularised, in order to find out their ideas on the subject. Nothing very definite transpired at once, but at all events discussion was stimulated, and in May, 1943, a resolution to form a single national organisation was put to the Chemical Convention at Montreal. The majority in its favour was overwhelming, and a joint committee to implement it worked on the scheme for a year. A report was presented to the Joint Councils in June this year, and was unanimously accepted. The story is told in full by Dr. R. V. V. Nicholls, of McGill University, who is Director of Information of the new Institute, in *Canadian Chemistry and Process Industries* (September, 1944, p. 636), and a list of the interim executive board is included.

The War Production Board, Washington has established a Tinned Scrap Section. The critical shortage of tin having been emphasised by its president, more than 100,000 members of the National Restaurant Association have joined the tin can salvage drive, the monthly goal of which is 40,000 tons.

Indian Chemical Notes

Tata Chemicals Progress

SINCE reference was made, in THE CHEMICAL AGE of October 21, to the visit to this country of a number of well-known Indian scientists, the following interesting advices were received regarding the establishment and subsequent large-scale development of the Tata Chemical Company of Mithapur. This company, which started production in 1939 at Mithapur, Baroda, with a capital of Rs. 5 crores, represents a pioneering industrial venture characteristic of the Tata interests. The plan for establishment of this new chemical plant, now claimed as the biggest in India, was drawn up by Mr. Kapilram H. Vakil, the present technical director of the company early in 1937. Later in the same year, the scheme was scrutinised by experts in London, under the chairmanship of Mr. J. A. Reavell, when it was found to be satisfactory and practicable.

Heavy Chemical Industry

The outbreak of the war within a few months of the start of the work at Mithapur seriously interfered with the execution of the project; progress was slow and halting, but despite many war-time difficulties, the project has been carried to a successful conclusion, and the company has started manufacturing several important chemicals, including alkalis, heavy chemicals, and marine products. Soda ash is manufactured by the ammonia-soda process, and the plant installed for the purpose incorporates the latest practices. As this substance is a most important starting material for the manufacture of drugs and dyestuffs and of caustic soda and sodium bicarbonate required in the glass, soap and paper industries, its successful production at Mithapur has gone a long way to meeting the need for an important basic chemical in India. Further, plants have been completed for the production of caustic soda by the electrolysis of brine, and gaseous by-products are already being utilised in the manufacture of bleaching powder, liquid chlorine and hydrochloric acid. Other chemicals now being manufactured include zinc chloride, bromides, Epsom salts, potassium chloride and magnesium chloride. In fact, Tata Chemicals are now manufacturing all the basic chemicals essential for the production of dyestuffs, fertilisers, glass, drugs and pharmaceuticals.

The Mithapur works, which are expanding rapidly, have already come to occupy an area of about 60 acres. Some 1500 workers and about 500 skilled personnel, including 200 highly qualified and trained chemists and engineers, comprise the staff. The works, planned, designed and equipped according to latest developments, have been provided with a well-equipped research laboratory. Moreover, the choice of site for India's new chemical industry has been a suitable one from the geological point of view because the large deposits of high-quality limestone in the Okhamandal area and the salt garden at Mithapur provide an abundant supply of important industrial raw materials.

Fertiliser Production Programme

A British technical mission which has been in India for some time, advising on the production of artificial fertilisers, recently recommended the erection of a single factory at a cost of about £7,500,000, with an annual output of 350,000 tons of ammonium sulphate, to be located at Harduaganj, near Aligarh, United Provinces. It will be necessary to import plant and equipment, especially high-pressure vessels. However, Indian producers will supply structural steelwork, cranes, pipes, etc. The factory cost of the product is estimated at about £8 10s. per ton. Our readers will recall, no doubt, that, in THE CHEMICAL AGE of November 25, reference was made to a similar enterprise to be started in Travancore (*see* p. 509).

The recommendations of the above mission—which consists of Mr. G. S. Gowing and Mr. J. Rigg of I.C.I., and Mr. T. H. Riley of the British Chemical Plant Manufacturers' Association—may be summarised by saying that no fertiliser other than sulphate of ammonia should be considered at present. However, research work should be undertaken to ascertain whether ammonium nitrate would be suitable under Indian conditions, in order to meet future needs for nitrogenous fertilisers made from material which should be cheaper to produce. It is important to note that a number of carefully selected Indian technicians are to be trained in fertiliser production in this country.

Early completion of this project is most desirable in order to achieve a more plentiful supply of high-grade fertilisers and, what is equally important, their widest possible distribution over the sub-continent. This will eventually result in improvements of the soil, which will go a certain way towards raising the nutritional standards of the Indian people. Furthermore, it is to be hoped that the research recommended by the commission will, making use of the results of previous investigations, lead to further valuable developments. In this connection, the question might be asked whether it is a wise policy to recommend the construction of a giant plant for the production of ammonium sulphate, when, by implication, the commision, in its report, envisages production of a cheaper fertiliser.

The Protection of Cellulosic Materials

Efficacy of Metallic Naphthenates

by W. J. CARTER, A.R.I.C.*

CELLULOSIC materials are used extensively in commerce and can be conveniently divided into two broad classes: (1) textiles, the production of which requires complex processing; (2) timber, which only requires preliminary trimming and drying before use.

These materials are generally subject to conditions where insects and micro-organisms may exert an important influence upon their general utility and length of useful service. The fibres of which they are composed are of organic nature and their structures have been the subject of extensive research and the theories based upon the results obtained have often caused considerable controversy. It is not proposed here to deal with this aspect of the position except in so far as the general theory assists in the interpretation of the specific cases of protection to be examined. Textile research has been mainly centred around the fibres concerned in the production of clothing, cordage, covers, and containers such as bags. The aspect of fibre composition, particularly of the coarse textile fibres, has been examined by Cross and Bevan[1] and A. G. Norman[2]. Cross and Bevan considered jute to be a typical example of the ligno-cellulose group of compound celluloses. Norman proposed a theory of association between cellulose and polysaccharides and coined the term "cellulosans" to denote this combination. A summary of this work, together with a survey of the rot-proofing position affecting textiles is contained in an article by S. G. Barker[3], who also deals with the economic advantages to be gained by using protective measures during the normal processing of textiles. The protection of cellulosic materials from degradation by means of suitable preservatives has developed rapidly during the last fifty years, and the rate has been greatly accelerated during the present war because of the limited imports of cotton, wool, timber and jute. The demands of the services have resulted in a considerable increase in the use of these commodities either fabricated or in the raw state.

It is obvious that the earlier the preservatives are applied, the smaller is the risk of degradation of the fibre. In the case of timber this is generally realised and the preservatives are applied immediately the material is processed and before any exterior coating is applied. In the field of textiles the reverse is often the case and the protective medium is applied after the preliminary processing has been completed. This means that if any compositions are used to aid the spinning or weaving operations or if fillers have been added to weight the fibre, they may act as barriers and prevent the penetration into the fibre of the preserving agents. The British Cotton Industry Research Association realised the need of preservation of textiles from fungi during processing and introduced salicyl-anilide to serve as a protecting agent during normal textile operations and in transit after manufacture. They do not claim that the quantity of this substance added during these processes is sufficient to provide immunity from attack by fungi during normal use after manufacture.

Causes of Degradation

There are three principal causes of degradation in fibrous materials: (1) photochemical decomposition; (2) action of fungi or bacteria; (3) action of animals such as termites, wood beetles, and shipworms.

The first of these is usually attributed to catalytic oxidation accelerated by light. Traces of certain metallic substances can act as catalysts also, increasing the rate of oxidation. It is essential, therefore, that the metallic portion of any fungicide should have a relatively low catalytic effect upon the oxidation of cellulose. Fungicidal action is always accelerated by warm, humid conditions, in which the spores multiply readily. Consequently, it is desirable to apply some form of antiseptic before the material is exposed for prolonged periods to such conditions.

Copper as a Preservative

For many years the insecticidal, fungicidal, and preservative character of copper salts have been known. In biblical times it was recommended that the vessels to be used for the storage of water should be constructed of copper. The use of soluble copper salts as an algicide is well established, but any soluble salt has a very limited application as a preservative, since it is essential to retain the copper within the fibres if a long and useful service is to be assured. Consequently, a search was instituted in order to obtain copper compounds which are relatively insoluble in water but are toxic to the types of fungi likely to attack cellulosic materials.

The use of such inorganic copper compounds is well known in horticulture and agriculture, where the well-known Bordeaux and Burgundy mixtures find extensive application. These are basic preparations produced by adding lime or sodium carbonate to an aqueous solution of copper sulphate.

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Since they are insoluble in water and organic solvents, very little use is made of them in the protection of cellulosic materials. One method of overcoming these difficulties and utilising the toxic properties of copper in the protection of cellulosic materials is the use of cuprammonium compounds. These are rarely applied in the fibre stage since their presence would interfere with subsequent processing. General practice is to treat the processed material by immersion in the cuprammonium solution, after which the ammonia and water are removed by heat, leaving a relatively insoluble copper compound attached to the fibre. The action of the ammonia upon the cellulose causes a reduction in the tensile strength of the fibre; the resulting lustrous finish, however, is attractive. The amount of copper which must be deposited to give even a limited protection is equivalent to 8 grains per square foot.

Development of Naphthenates

Forty years ago an advance was made in the use of copper compounds by the introduction of organic compounds in which the acid radical has itself toxic properties. This development took place in Denmark where the toxic properties of the naphthenic acids were first utilised on a commercial scale. It was found that these naphthenic acids could be combined with certain metallic salts to form metallic naphthenates which are soluble in certain organic solvents, and are highly toxic towards the fungi responsible for the degradation of cellulose in cellulosic materials. An excellent account of these acids together with the methods employed for their recovery during crude oil refining can be found in the literature.[4]

The naphthenic acids consist of compounds with a general formula $C_nH_{2n}O_2$ and are probably mixtures of isomers and homologues with a cyclopentane structure. Naphtali[5], in an attempt to explain their formation, postulates the presence of

$$CH_2.CMe_2.CHMe.CH_2.CHCH_2.CO_2H$$

and relates it to trimethylcyclopentanone, which is obtained from wood. Owing to the complexity of these compounds it is not possible by standard methods to produce material of constant chemical constitution. The uncertainty of the exact composition of any batch has prevented fundamental work on the mechanism of the toxic action of the naphthenates from being published. In spite of the above difficulties commercial production of a material of constant toxicity is possible by obtaining acids from the same source and utilising standard methods of refining. Nevertheless, it is hoped that in the near future it will be possible to isolate the constituents of these mixtures and produce crystalline derivatives from which toxicity standards may be obtained.

A comparison of the fungicidal value of 50 copper compounds has been carried out at Bristol University Agricultural Station.[6] These workers suggest that the action of the fungicides depends on a reaction with the exudate from the spores, thus releasing toxic copper ions. They have found that in many cases the toxicity of the compounds was entirely due to the copper present, but in some cases, particularly the phthalate and sebacate, the acidic radical or the undissociated molecule also possessed toxic properties. Although, as previously mentioned, the naphthenates were not compared, a considerable accumulation of results indicates that both the copper and naphthenic acid radicals are toxic. A recent article[12] deals with the results obtained from tests comparing the toxic properties of copper oleate, tallate, resinate, and naphthenate. The writers interpret the results as showing that copper naphthenate is superior to the others at equal concentrations.

It has been shown that *Staphylococcus aureus* will be destroyed by a 1 per cent. naphthenic acid emulsion in less than 30 minutes. This is equivalent to the action of a 3 per cent. phenol solution. The effect of alkali naphthenates is of a somewhat lower order upon this particular organism but is superior to the acid in the case of *Bacillus communis*. Bachrach[7] found that a 16 per cent. aqueous solution of potassium naphthenate destroyed *S. aureus* in five minutes at 20°C. This meets the definition of the Food and Drugs Administration for an antiseptic. In another test a phenol coefficient of 0.1 per cent. was obtained with the action of potassium naphthenate upon *B. typhosus*, the coefficient being based on the anhydrous potassium naphthenate content. The addition of 1 per cent. sodium naphthenate to a 10 per cent. starch solution inhibited decomposition. This and other evidence indicates that other naphthenates, in which the metallic portion of the molecule is not so toxic as is that of copper, may be used as fungicides without decrease of protective efficiency.

Timber and Textile Protection

From the above data it is also logical to assume that the lethal dose of copper naphthenate will be much smaller than that of a copper compound relying entirely upon its copper content for its toxicity. This would be so where a naphthenate treatment is compared with cuprammonium, copper oxide, or metallic copper impregnation, and therefore if a specification is to be of commercial value it should not be based on the metallic copper content but on the equivalent toxicity of the copper compound used as the preservative. In addition, it should include the use of other metallic naphthen-

ates which have an equivalent toxicity to that of the copper to be employed as a treatment in cases where the colour of the copper naphthenate is objectionable. This would also allow for the inclusion of metallic preservatives in which the metal is a poor catalyst for the photo-chemical decomposition of cellulose compounds.

Extensive tests have been carried out using metallic naphthenates as fungicides particularly in the case of timber, textiles, nets, cordage, sailcloth, sandbags, and waterproof covers. The Forest Products Research Laboratory[8] has carried out tests with Scots pine and beech timber blocks treated with copper, zinc, and iron naphthenates. The original report, showing the effect of the preservatives on the growth of the fungi *Lentinus lepideus*, *Coniophora cerebella*, and *Polystictus versicolor*, may be examined at the laboratory. Textiles treated with metallic naphthenates and other preservatives have been examined by the Linen Industry Research Association and others. Elkin and White[9] give the following results:

TABLE 1

Comparison of the Effect of Rot-Proofing Compounds on the Resistance of Jute to Attack by Micro-Organisms.

Treatment	*Metal Content*	*Loss in Strength*
Copper oleate	1.4% Cu	Nil
"	1.3% Cu	Nil
"	1.1% Cu	6%
"	0.8% Cu	4%
Zinc oleate	1.4% Zn	30%
"	1.1% Zn	42%
"	0.9% Zn	48%
"	0.8% Zn	56%
Copper naphthenate ...	1.1% Cu	Nil
" ...	0.8% Cu	3%
Zinc naphthenate ...	1.1% Zn	Nil
" ...	0.6% Zn	Nil
Cuprammonium (Coml.)	1.8% Cu	4%
Creosote	—	10%
Cutch chrome	0.3% Cr	63%
Untreated	—	71%
Paraffin	—	71%

It will be observed that the zinc naphthenate treatment with a zinc content of only 0.6 per cent. conferred immunity and is equivalent in effect to 1.4 per cent. copper as copper oleate.

Tests in Mines

The Transvaal Chamber of Mines Research Laboratories[10] have carried out tests with metallic naphthenates upon timber, cellulosic wearing apparel and filter bags. These tests were made with canvas as test material, using 4.2 per cent. and 8.4 per cent. zinc and copper naphthenate emulsions as preservatives. The breaking strain of the material was determined before and after test, and the efficiency of the treatment is expressed as a percentage of the tensile strength of the control. Table 2 shows the results.

In an endeavour to increase the life obtained from boots worn by native miners underground, a service test was commenced at Nourse Mines, Ltd., to determine whether treatment of the boots with a mixture of metallic naphthenate and castor oil would bring about an appreciable increase in the life of those boots. Isolations made from decayed stitching from boots used underground have revealed the presence of a number of micro-organisms.

Four pairs were treated by brushing the uppers with 24 per cent. copper naphthenate solution and dipping the soles into the oil; two pairs had uppers brushed with a mixture of equal parts 24 per cent. copper naphthenate solution and pure castor oil, while the soles were dipped in 24 per cent. copper naphthenate solution only, with the following results.

TABLE 3

Employment of Boys	*Treated Boots Life-Days*	*Untreated Boots Life-Days*
Lashing	217	82
Barring and Lashing ...	216	114
Tramming	208	173
Drain Boy	153	180
Tramming	130	114
Lashing	191	119

A laboratory experiment with pitch pine wood blocks to determine the efficacy of ammoniacal liquor as a diluent for copper naphthenate, for use on shaft timbers led to the conclusion that a 24 per cent. copper naphthenate solution, when diluted with paraffin or ammoniacal liquor, proves to be quite effective in the preservation of pitch pine test pieces when tested under laboratory conditions against a number of test fungi at concentrations of 1.2 per cent. copper naphthenate.

To determine the efficacy of copper naphthenate solution under service test, two pieces of brattice cloth were treated with this preservative in the following manner. Half of one piece was treated with 24 per cent. solution of copper naphthenate and the remainder left untreated to act as control. The same procedure was adopted with

TABLE 2

Treatment	Fungi: *Stachybotys Sp.*			*Chaetomium Ciobosum*		
	Tensile Strength		Treatment Expressed as % of Control	Tensile Strength		Treatment Expressed as % of Control
Emulsion Containing	Control lb.	Test Piece lb.		Control lb.	Test Piece lb.	
4.2% zinc naphthenate	150	131	87	150	136	91
8.4% zinc naphthenate	123	132	100+	123	138	100+
4.2% copper naphthenate	141	140	100+	141	130	92
8.4% copper naphthenate	154	131	85	154	151	98
Untreated	144	1	Nil	144	1	Nil

the second piece, using iron naphthenate for treatment.

After a period of five months the untreated portions of the cloth were showing extensive mould growth and considerable thinning and on being subjected to pressure they tore readily, whereas the treated material was sound. After 10 months the untreated material had decayed, and both the iron- and copper-naphthenate-treated materials were still in a sound condition. After a period of 1 year 10 months, the treated fabric had deteriorated and was commencing to disintegrate. If anything, the copper-naphthenate-treated material was in a better condition than the iron-naphthenate-treated material.

Treating Filter Bags

Laboratory experiments have established conclusively that the chief cause of destruction of flannel used in mines for air filtration is the attack by fungi on the wool fibres from which flannel is made. A number of dust filtration bags were therefore treated with preservatives and sent to various mines for testing under service conditions. Two tests were carried out.

(a) A flannel air-filtration bag measuring 9 ft. by 24 in. was dipped in copper naphthenate and allowed to dry out. The temperature in the vicinity of the bags was: dry bulb 82° F; wet bulb 80° F. The quantity of air passed by the bag when clean was 2000 cu. ft. per min. The bag was inspected periodically.

(b) Two flannel air-filtration bags, measuring 20 ft. by 20 in., were dipped respectively in a 24 per cent. solution of copper naphthenate, and in a 24 per cent. solution of zinc naphthenate. After thorough immersion the bags were wrung out to remove excess solution, and were hung up to dry in the sun.

The bag treated in test (a) lasted 442 eight-hour shifts in the same locality in which the average life of an untreated bag is 90 eight hour shifts. Treatment with naphthenate, therefore, considerably increased the life of the bag. The bags treated in test (b) lasted for 607 shifts when treated with 24 per cent. copper naphthenate and 630 shifts when treated with 24 per cent. zinc naphthenate solution. The treatment with both these grades of naphthenate considerably increased the life of the flannel bags (untreated bags lasted for 120 shifts), but there was very little perceptible difference in efficacy between these two grades.

It will be observed from the above results that zinc naphthenate gives excellent protection in conditions where only very humid conditions are encountered during service. Zinc naphthenate is an excellent emulsifying agent; this may account for the lower toxicity figures obtained from fabrics treated with it after outdoor exposure, owing to mechanical emulsification and subsequent removal of the preservative. That all filter bags exposed to humid conditions should be treated with a suitable preservative is amply proved by the results obtained, since without impairing the filtration efficiency the useful life period was extended five times.

Marine Rope Tests

The preservation of coarse fibres such as manilla, sisal, coir, jute, etc., has been tested with ropes and nets by the Marine Biological Association. Many papers have been published by W. R. G. Atkins[11] showing the results obtained from exposing specially treated ropes on Plymouth Sound.

In these reports five tabulated series are given showing a comparison between naphthenate and other preservatives. The table appended is a summary of the results given in the above series of tests. A 2 in. sisal rope immersed in preservative for 24 hours after drying gave the following results of tensile strength: 7½ months = 3320 lb.; 12 months = 3300 lb. If this is taken as 100 per cent., the untreated control after exposure was equivalent to 13 per cent., and the copper naphthenate to 82 per cent

TABLE 4

	Per cent.
Copper naphthenate 24 per cent., tar formula, with equal vol. of petrol	82
Copper oleate, 100 per cent. in Corroid tar ...	78
Copper naphthenate 24 per cent., tar formula...	76
Copper resinate, 10 per cent. in Coalite heavy oil	75
Copper oleate, 10 per cent. Coalite tar, 20 per cent. in Coalite neutral oil A	70
Copper resinate, 10 per cent. in creosote oil ...	70
Untreated Control	13

It is hoped that the publication of this extremely brief account of the protection that can be given to cellulosic materials will stimulate further work and a general adoption of preserving agents where cellulosic materials are liable to the influence of micro-organisms.

ACKNOWLEDGEMENT

The author would gratefully acknowledge the assistance he has received from K. Turner, H. Martin, L. C. Galloway, W. Findlay, and his colleagues at the National Smelting Co., Ltd. He is also indebted to the Imperial Smelting Corporation, Ltd., for permission to publish the article.

REFERENCES

1 CROSS and BEVAN, *Researches*, 1912.
2 A. G. NORMAN, *Biochem. J.*
3 S. G. BARKER, *Chem. and Ind.*, 1938 (Dec. 31), p. 1222
4 CARLETON ELLIS, The Chemistry of Petroleum Derivatives (Chapman & Hall); M. D. CURWEN, *Oil Col. Tr. J.*, 1935, **88**, 1711.
5 M. NAPHTALI, *Z. angew. Chem.*, 1930, **43**, 1051.
6 MARTIN, WAIN, and WILKINSON, *Ann. Appl. Biology*, **29**, No. 4.
7 D. J. BACHRACH, *Soap*, 1934, **10**, 11, p. 21; *see also* LEVINSON and MENICH, *Soap*, 1938, **14**, 12, p. 24.
8 Forest Products Research Lab., Princes Risborough, Private Communication.
9 ELKIN and WHITE, *J. Text. Inst.*, 1935, **26**, 7, p. 202.
10 Transvaal Chamber of Mines, Private Communication.
11 *Rep. Marine Biolog. Assoc. U.K.*, 1936, **20**, 3.
12 MARSH, GREATHOUSE, BOLLENBACKER, and BUTLER, *Ind. Eng. Chem.*, 1944, **36**, 177.

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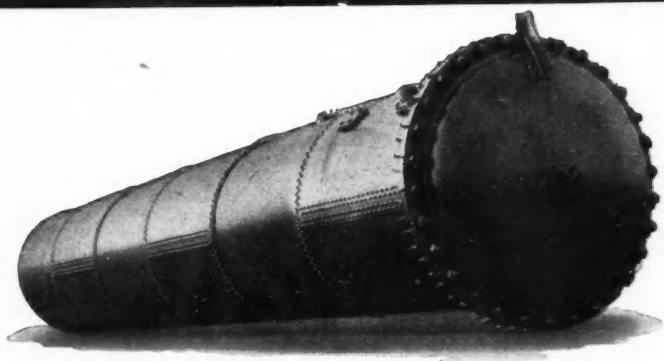

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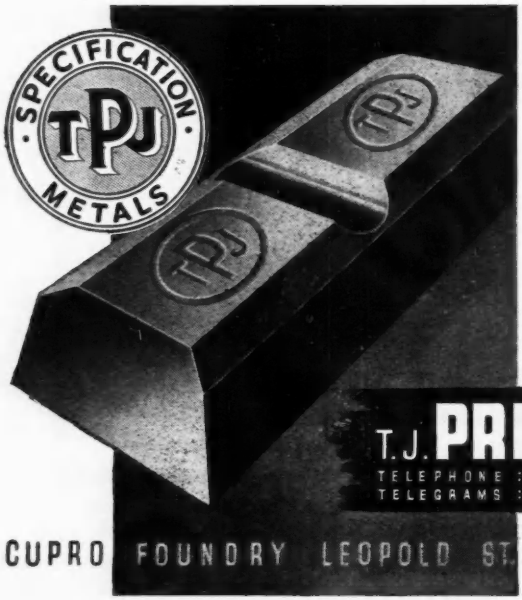

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Metallurgical Section

December 2, 1944

Acid-Resisting Steels*

Construction Materials for Chemical Plant

THE corrosion-resistant chromium steels, containing more than 12 per cent. Cr., and acid-resistant chrome-nickel steels of the 18/8 class, which have been available to industry now for about 25 years, have for the last two decades found widespread application in the chemical industry, particularly as material for the construction of chemical apparatus and plant. During this period, as a result of both the industry's special requirements and demands, and of the desire to conserve valuable alloying metals such as Ni, Mo and Cu, further developments have taken place. Practical experience shows that, for many purposes, plain Cr, Cr-Mo, Cr-Mn or Cr-Mn-Ni steels may be employed instead of the customary 18/8 stainless steels. Consequently, during the last decade, a whole series of corrosion-resistant steels, suitable for different applications and working conditions, has been developed. These more recent materials have largely displaced other constructional metals, which were less suited to the purpose, either from mechanical considerations or because of less satisfactory chemical properties. Metals and alloys, satisfactory in use, but costly as constructional materials, have also been largely displaced—in this class fall such metals as copper, nickel, bronze, Monel and silver.

Knowledge of the properties of the more recent corrosion-resistant steels has, in some cases, made possible the large-scale application of new chemical processes, as well as an improvement in existing methods; with a resulting increase in production, by using such materials with superior properties, which enables more severe operating conditions to become practicable. These steels are used, for instance, as construction materials in the nitric acid and sulphite cellulose industries and in dyeworks plant. The most important corrosion- and acid-resistant steels which to-day are employed in the chemical industry are shown in Table 1, which gives also a review of their mechanical properties, structure and grain stability. The main constructional applications are for such purposes as vessels, plant, piping, etc.

Of no less importance than stainless steels, are the various steel alloys used for special purposes, such, for instance, Cr-Ni steels with high Mo and Cr contents which have proved to be resistant against sulphuric acid. In addition, mention should also be made of the high carbon chrome steels, which find application for surgical instruments and cutting machinery, and the corrosion-resistant Cr and Cr-Ni steels, with additions of Se or S (MoS_2), used in the fabrication of automatic machines. Finally, in this class belong also the special Cr-Mn-Ni steels, characterised by their freedom from strain-corrosion, and their non-magnetic properties, used notably in the form of wire. In a class by themselves are the heat-resisting steels of which the 20/20 Cr-Ni steel has now been used for some 20 years in the glass, porcelain and furnace industries; this steel has been the starting point for the development of a number of heat-resisting steels, such as the Cr, Cr-Si, Cr-Si-Al, Cr-Mn, and Cr-Ni steels. Further development has resulted in the highly heat-resistant Cr-Ni-W (Mo, V) and Cr-Mn-W (Mo, V) steels, used for hot drop-stamping and forging press bolsters and dies, and in the Cr-Si, and Cr-Ni-W (Mo) and Cr-Mn-W (Mo) steels, used in the construction of exhaust-fans for hot gases. In this last instance, surface hardening by nitriding in ammonia gas is usual on account of the exceptionally severe service requirements.

Four Main Groups

The steels given in Table 1 fall into four main groups as regards their composition, micro-structure and properties, *viz* :—

1. The magnetic Cr steels with ferritic-pearlitic structure (steels Nos. 1-4).
2. The non-magnetic Cr-Ni steels with austenitic structure (steels Nos. 5-10).
3. The non-magnetic Cr-Mn steels, with austenitic structure (steels Nos. 11 and 12); and
4. The weakly magnetic Cr-Mn steels, with semi-austenitic structure (steels Nos. 13 and 14).

The alloying element for all the steels in Group 1 is chromium, on which essentially depends the passivity against corroding agents In order that a steel of this

* From an article in *Chemische Fabrik*, 1941, *12*, 231, by R. Weihrich and A. Rasch, of Poldihütte, Kladno, Czechoslovakia.

TABLE 1

Corrosion Resistant Steels for Equipment used in the Chemical Industry.

Group	Steel No.	Chemical Composition C	Mn	Si	Cr	Ni	Mo	Other Elements	Nature of heat-Treatment	Mechanical Properties Yield Point kg/mm²	Tensile Strength kg/mm²	Elongation 1—10 d.	Contraction %	Erichson Value 1 m/n. Sheet	Texture	Resistance to intercrystalline corrosion
1	1	0.2	0.5	0.25	15	—	—	—	Cast	55—65	75—90	14—12	55—50	—	Pearlite-Sorbite	—
	2	0.1	0.5	0.25	17	—	—	—	Annealed at 770°C.	32	55	20	60	8	Ferrite & pearlite	limited
	3	<0.1	0.5	0.25	17	—	—	Ti, Ta, Nb	do.	32	55	20	55	7	do.	good
	4	<0.1	0.5	0.25	18	—	1.5	—	do.	40	60	15	50	7	do.	limited but with Ti, Ta, Nb, as good as 3
2	5	<0.1	0.5	0.9	18	8	—	—		25	65	55	60	13	Austenite	good if C is <0.07
	6	<0.1	0.5	0.9	18	8	—	Ti, Ta, Nb	Quenched 1100°C.	28	68	45	60	11	Austenite & carbide	good
	7	<0.1	0.5	0.5	18	8	2.5	—	do.	30	65	40	50	11	Austenite	good
	8	<0.1	0.5	0.5	18	8	2.5	Ti, Ta, Nb	do.	30	70	40	50	10	Austenite & carbide	good, especially if C <0.07
	9	<0.1	0.5	0.9	18	8	1.7	—	do.	27	65	50	60	12	Austenite	
	10	<0.1	0.5	0.9	18	8	1.7	Ti, Ta, Nb	do.	30	65	35	60	11	Austenite & carbide	good
3	11	0.1	18	0.5	9	0.5	—	Mo, Ni, Cu	Quenched 1000°C.	28	70	50	55	13	Austenite	bad
	12	0.1	14	0.5	18	1.5	—	—	do.	40	70	45	55	12	Austenite	good
4	13	0.1	9	0.5	18	1.5	—	—	do.	40	80	40	40	10	Austenite & ferrite	limited
	14	0.1	11	0.5	18	0.5	1.7	Cu	do.	40	80	40	40	10	Austenite & ferrite	good

TABLE 2

Comparative Corrosion Test Results at 20°C.

Steel No.	% C	Mn	Cr	Ni	Mo	Loss in weight g/m²/hr. NaCl (5%)	HNO_3 (1%)	H_2SO_4 (1%)	HCl (1%)	Acetic acid (1%)	H_2SO_3 (2%)	Oxalic acid (1%)
1	0.2	0.35	15.5	—	—	0.02	0.08	3.4	8.9	0.01	2.5	0.22
4	0.05	0.38	17.7	—	1.38	0.00	0.00	1.15	3.7	0.00	0.24	0.07
5	0.06	0.45	18.7	9.4	—	0.00	0.00	0.005	0.30	0.00	0.00	0.005
9	0.10	0.40	18.5	9.2	1.76	0.00	0.00	0.005	0.25	0.00	0.00	0.005
11	0.11	17.7	8.6	0.6	0.3	0.04	4.9	*	*	0.02	*	0.50
12	0.07	13.8	17.8	1.35	—	0.005	0.00	4.5	*	0.00	0.02	0.01
13	0.09	9.1	17.7	1.45	—	0.005	0.005	5.7	*	0.00	0.01	0.03

* Loss in weight over 10 g/m²/hr.

class may be considered as corrosion-resistant, the chromium content must exceed 12 per cent., and where acid-resistance is required, the Cr content must amount to 15-20 per cent., and any economy in the use of chromium is hardly possible (*see* Fig. 1). The 16-18 per cent. Cr. steels are characterised by a ferritic microstructure, which is converted to an austenitic structure by the addition of 8 per cent. Ni. The characteristic properties of the 18/8 Cr-Ni steels, after quenching from 1100°-1150° C., such as increased corrosion resistance, good ductility, deep drawing and welding properties, are attributable, to a large extent, to this austenitic structure. Unfortunately, however, this does not apply in the same degree to the straight Cr-Mn steels. Roughly, manganese has only half the austenitic-forming properties of nickel, which means that to obtain a full austenitic Cr-Mn steel, with a simultaneous lowering of the Cr content, additions of more than 14-18 per cent. of manganese are required. The degree of resistance to chemical corro-

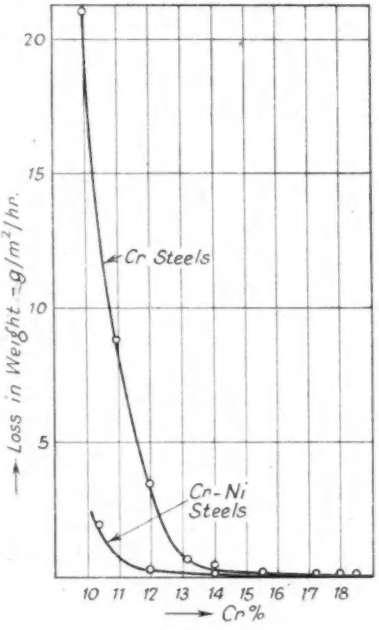

Fig. 1.

sion is, however, lowered thereby. In order to prevent a pronounced decline, the higher Cr content of 15-18 per cent. is maintained and in order to retain a stable austenitic structure 2 per cent. of nickel is usually added.

The alternative is to choose a lower Mn content and to be satisfied with a semi-austenitic structure—i.e., a micro-structure

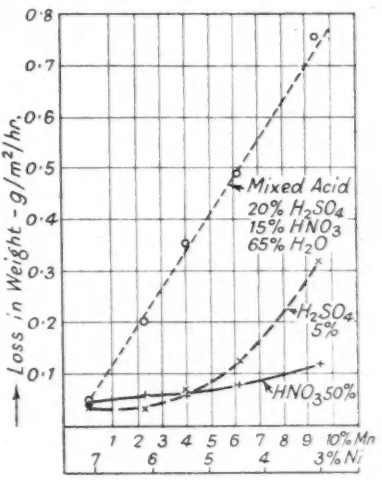

Fig. 2.

which still contains, besides austenite, a large amount of ferrite. Some comparative corrosion-tests regarding these Mn stainless steels are given in Table 2. The falling off in the corrosion-resistance of the Cr-Ni steels, with increasing amounts of Mn, is shown in Fig. 2.

In order to increase the acid-resistance, steels 1-4 may contain up to 3 per cent. Mo as well as up to 2 per cent Si. Further, with the exception of the Cr-Mn steels, they may also contain, from the point of view of welding properties, carbide-forming elements. These additions, and other measures, such as the lowest possible carbon content, have the object of preventing intercrystalline corrosion (boundary corrosion, grain-decay). This structural defect in use (weld-decay) was originally very troublesome, particularly in the case of the 18/8 acid-resisting steels. Originally, these steels had, as a rule, a higher carbon content than to-day; manufacturing progress was gradual and no comprehensive welding experience was available to begin with.

It would be starting from false premises to assume that the higher alloyed steels are the only ones which are suited for building chemical plant. Sufficient information is available to show that quite often the lower alloyed steels are, for specific objects and uses, more suitable than the higher alloyed

materials. For example, the thick-walled high-pressure vessels, used for the ammonia synthesis, were, according to Claude, constructed from high nickel alloys, containing 56 per cent. and more of nickel. However, the much lower alloyed 12/12 Cr-Ni steels with additions of tungsten and vanadium, have for many years proved to be more satisfactory. Calenders used in the paper industry, originally made from bronze, and later from 18/8 Cr-Ni steel, have, for some time, given equally good results if produced from Cr-Mu steels (steel No. 12 or 13) and straight Cr-steels (steel No. 1). In place of 18/8 stainless steel for plant used in the milk industry, Cr steels, or Cr-Mn steels are satisfactory (steels Nos. 2, 3, 12 and 13).

TABLE 3
Results of some Corrosion Tests with Steels Nos. 1–5, 9, 13 and 14.

Steel No.	%						Loss in weight g/m²/hr. at 90°C.	
	C	Mn	Cr	Ni	Mo	Ti	Nitric acid (50%)	conc. Acetic acid
1	0.2	0.35	15.5	—	—	—	0.28	0.21
2	0.1	0.42	16.8	—	—	—	0.11	0.15
3	0.06	0.38	17.7	—	—	0.75	0.10	0.12
4	0.05	0.38	17.7	—	1.28	0.7	0.05	0.06
5	0.06	0.45	18.7	9.4	—	—	0.03	0.10
9	0.10	0.40	18.6	9.2	1.76	—	0.02	0.05
13	0.00	9.1	17.7	1.45	—	—	0.27	0.12
14	0.10	9.7	17.7	1.4	2.0	—	0.09	0.07

Straight Chromium Steels

The territic Cr steels, with roughly 17 per cent. chromium, are almost equally resistant to corrosive substances as the 18/8 Cr-Ni austenitic stainless steels. They show good corrosion-resistance, and are further resistant to nitric acid, nitrous vapours, fats, oils, and alkali solution as well as to many salt solutions (*e.g.*, copper sulphate, photographic developers, etc.). These steels are, however, not sufficiently resistant against sulphuric and hydrochloric acids and chloride solutions, especially as regards heavy metal chlorides. Chlorides in general, and those of heavy metals in particular (and to some degree also hydrochloric acid), give rise to localised attacks on the metal, unlike the uniform corrosion experienced, *e.g.*, with sulphuric acid. This localised attack is termed cell-corrosion or pitting. The Cr-Mn steel (No. 4) is, in general, more resistant than the straight chromium steel, especially with organic acids, such as acetic acid, and to both contact and local corrosion, and it is therefore recommended as a steel resistant to sea water. Nevertheless, in such cases the use of a proven 18/8 Cr-Ni steel should be considered.

The mechanical properties of Cr steel (No. 1) are better than those of the Cr-Ni steels. Steels with a low carbon content (Nos. 2 and 4) may be cold-formed and deep-drawn, similarly to mild steel. The ductility of these steels is, however, lower than that of Cr-Ni steels. A disadvantage of the straight Cr steels, is, that if heated to over 950°C., grain-growth takes place, which causes increasing brittleness, which cannot be removed by heat-treatment. Welding of these steels should, therefore, be carried out only if the mechanical requirements in use are very moderate, and no subsequent difficulties arise only if the lowest possible carbon content is alloyed, with sufficient quantities of Ti, Ta or Nb (Steel No. 3). These additions not only delay the grain growth of straight Cr steels, but also prevent boundary-decay (intercrystalline corrosion). These steels are selected for welding constructions only in the case of non-pressure vessels if the welding is performed with the electric arc, using electrodes of appropriate composition.

Chromium steels are particularly suitable for application in the solid form, for shafts, spindles, valves and valve seatings, and parts of valves. Other applications where they may be used advantageously include equipment for the nitric acid and explosive industries, and for welded constructional plant in the milk, soap, fat and food processing industries, for alkaline and neutral dyeing, photographic plant, etc.

(To be concluded)

STRUCTURAL ALLOYS

What the structural engineer thinks of the possibilities of light alloys was indicated at Birmingham last week, when Mr. D. V. Pike surveyed the post-war potentialities of aluminium alloys, in a talk to the Institute of Structural Engineers. The high strength and light weight of these alloys, he said, makes them particularly attractive for such structures as long-span bridges, swing bridges, cranes, and roofs with long unsupported spans. Lower costs of handling and transport, and little need for maintenance, were further advantageous features. Dr. E. G. West, manager of the Wrought Light Alloys Development Association, emphasised the part played by British engineers and metallurgists in bringing aluminium alloys to their present high degree of efficiency and trustworthiness.

Galvanised Coatings and Zinc

Corrosion Research

A STUDY of "Corrosion of Galvanised Coatings and Zinc by Waters containing Free Carbon Dioxide," made by L. Kenworthy and Myriam D. Smith, is recorded in *J. Inst. Met.*, 1944, *70*, p. 463. Their general conclusions, as regards both hot and cold water, are that: (i) The attack of zinc and galvanised mild steel by conductivity water, a hard public supply water, and a mixture of the two in equal proportions, is, both at 18° and 85° C., in general increased by increasing the original free carbon dioxide content of the waters. (ii) The amount of zinc entering into solution increases progressively with increase in carbon dioxide content, and the corrosion product formed becomes increasingly soluble. (iii) The pitting of zinc is found to be more rapid than that of galvanised coatings.

Cold-Water Corrosion

Investigations in cold waters show that zinc is dissolved at a uniform rate with time. For corresponding carbon dioxide contents, the conductivity water is more corrosive than the hard or mixed waters. Below a concentration of about 2 parts/10^5 carbon dioxide, the hard water is more corrosive than the mixed water, but above this concentration the position is reversed. The relative corrosive actions of the three waters are attributed to the changing balance between the salt concentrations and the carbon dioxide contents. There is a tendency in all cases for pitting to be more severe in waters low in free carbon dioxide, but this is much more marked in conductivity water than in the hard and mixed waters. In the absence of scale formation and loose deposits, the life of sound galvanised coatings in cold supply water depends on their total thickness, the outer zinc and the alloy layer being attacked at a uniform rate with time. Under certain conditions, where zinc suffers more severe pitting than do zinc-iron alloys, the coating life for a given thickness will increase with the proportion of alloy layer present. The authors found that the zinc-iron alloy layer of a hot-dipped galvanised coating affords no electrochemical protection to the basis steel in cold supply waters. Damaged or incomplete coatings will therefore decrease in effectiveness with decrease in the amount of unalloyed zinc present.

In the case of zinc specimens in hot waters considerable pitting occurs, and the pits are fewest in water free from or with the lowest carbon dioxide content tested. The rate of penetration by pitting is, however, greatest with the water containing 0.56 part/10^5 free carbon dioxide. Failure of galvanised specimens takes place by rusting at isolated spots, frequently at the centres of "cups" of corrosion products which form originally when bubbles of gas separate out on the specimen. Galvanised specimens with bare steel exposed, *e.g.*, cut edges, rust after only three days in hot water. It follows that, in marked contrast to the behaviour in cold water, the zinc fails to give any appreciable electrochemical protection to exposed steel.

Rusting of galvanised specimens occurs when from 50 to 80 per cent. of the original weight of coating remains on the specimens and the amount of coating remaining at the time of rusting decreases with increase in carbon dioxide content. Comparatively rapid failure of galvanised specimens took place in water containing only 0.56 part/10^5 free carbon dioxide, the rate of penetration by pitting of the coating being equivalent to approximately 3.0 oz./ft.^{2}/year. When the original free carbon dioxide content was increased to approximately 1 part/10^5, failure was much less rapid despite increase in the amount of zinc entering solution. With further increase in carbon dioxide content the rate of penetration of the coating increased progressively. Comparatively high figures for zinc in corrosion products were also found with water containing 0.56 part/10^5 carbon dioxide with both the zinc and galvanised specimens. This maximum rate of attack in a comparatively low range of carbon dioxide content may be due to periodic changes in acidity as cold water relatively high in carbon dioxide is admitted and heated. The protective film formed on heating the water may be redissolved by the relatively acid cold water.

Composition Recommended

The authors' recommendations, as regards composition, are that it is necessary to manufacture a type of coating designed to provide a reasonable degree of protection against the majority of service conditions. All things considered, a hot-dipped coating, comprising approximately equal proportions of outer zinc and alloy layer, would appear most nearly to fulfil these requirements. Electrogalvanised coatings and all alloy coatings, although advantageous in certain circumstances, do not possess the same all-round degree of protection. Reduction of the free carbon dioxide content and maintenance of a reasonable degree of hardness of cold supply waters are of great value in prolonging the life of zinc coatings with which the water comes in contact. Further work is, however, necessary before recommendations can be made regarding the prevention of corrosion of galvanised tanks by hot waters.

Magnesium Alloys

Improved Technique and Wider Uses

MARKED improvements have been made in recent years in the mechanical properties of the magnesium alloys, according to an article in a recent number of *Iron Age*.* Sand castings exhibiting excellent mechanical properties and uniformity can be produced. In addition, wrought alloys have been developed which can be extruded faster and have a higher mechanical strength. New methods for forming magnesium sheet have been developed and research to improve forging practice is underway.

In the field of resistance to corrosion, improved methods of surface protection have been introduced. It has been found that corrosion-resistance is greatly improved by reducing impurities in magnesium. Iron, in particular, when present in excess of 0.005 per cent., impairs resistance to corrosion. On the other hand, it has been shown that a small percentage of manganese is beneficial in this respect.

Welding technique has been so improved that magnesium alloys are readily joined by torch welding. The welds produced are from 60 to 90 per cent. as strong as the parent metal. Spot welding and electric welding by the Heliarc process (which does not require the use of salt fluxes) are now carried out as a normal procedure. In the foundry, the improvement of fluxes for remelting magnesium alloys has considerably reduced the loss of metal by oxidation.

In the Chemical Industry

The following points are of special interest to the chemical industry. Although magnesium is attacked and dissolved by most acids, hydrofluoric and chromic acids have little or no effect on it. In addition, it is highly resistant to solutions containing alkalis, borates, fluorides, and chromates. Cylinders for solidifying caustic soda and apparatus for making hydrofluoric acid have been made in magnesium with considerable success. Magnesium powder is being used in the hydrogenation of oils, and shavings are used in the drying of oils and for the purification of certain gases. Magnesium is also used as a catalyst in the formation of complex organic compounds.

The affinity of magnesium for oxygen and nitrogen is taken advantage of in the foundry industry where the metal is used as a deoxidiser and scavenger. The addition of pure magnesium to lead and to white metals assists in the removal of bismuth and cleanses the melt. Similarly, it may be used for the treatment of molten brass, bronze, copper, nickel, nickel-silver and Monel metal.

* "Improved Magnesium Alloys and Technique Expand Post-War Field," *Iron Age*, 1944, *154*, 96.

Fluorspar in Steel

Substitutes Used in U.S. Process

DIFFICULTIES in obtaining sufficient fluorspar in America for use in the basic open-hearth process of steelmaking have led to the adoption of various alternatives with a view to economising in spar. Mr. J. L. Gregg, of the Bethlehem Steel Company, Pennsylvania, presented a paper dealing with "Chemicals Used in Steel Industry" to the April meeting of the Chemical Market Research Group, and this is reprinted in *Chem. Eng. News* (September 25, 1944, p. 1555).

In 1943, he says, the American open-hearth steel industry used 232,000 tons of fluorspar, as an addition to the 931,600 tons of burnt lime charged, in order to promote the solution of the lime in the slag. Various expedients have been employed to make up the required quantities of promoters in place of fluorspar. Mill scale, either alone or mixed with spar, has helped in keeping spar consumption down. Bauxite has been reported to be a satisfactory substitute, but there is a better use for bauxite. Some producers have tried common salt as a substitute, but this may be poor practice, because of the fluxing action of the salt on the refractories. Mr. Gregg's own company has used a few loads of topaz, obtained from a deposit of the massive mineral, and the results with this material were encouraging.

Spar is also used in the manufacture of electric-furnace steel, but the amount used is much smaller than that used in the open-hearth, because of the relatively small production of electric-furnace steel as compared with that of open-hearth steel.

The recent tendency for steels to become contaminated with tin, in amounts up to 0.5 per cent., probably because of the war-time use of scrap of dubious composition, gives additional interest to a recent note by Robertshaw and Bromfield (*Analyst*, 1944, *69*, 824, p. 340), outlining a convenient and efficient method for determining tin in steel. The apparatus required is relatively simple, and is clearly depicted in a diagram.

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Personal Notes

MAJOR KENNETH GORDON, of Norton-on-Tees, a joint managing director of I.C.I., Ltd., received the C.B.E. at the recent Investiture at Buckingham Palace.

MR. C. J. GOODWIN has left for an extensive business trip to the United States and Canada, where he will stay for about three months.

MR. R. H. BRIGGS, M.B.E., Assistant Director, Scientific and Technical Censorship, Ministry of Information, has been elected from associateship to membership of the Institution of Mechanical Engineers.

MESSRS. L. A. ELGOOD and C. G. GRAHAM HAYMAN (directors of the Distillers Co., Ltd.) and MR. J. F. STRABLE (director of Gyproc Products, Ltd.) were elected to the board of British Plaster Board, Ltd., at a meeting of directors of that company on November 21.

The work of MR. HAROLD WRIGHT, chief metallurgist of Dorman, Long & Co., Ltd., who joined the group 61 years ago, is recognised by the endowment of a triennial lecture, known as the Harold Wright Lecture, to be given by an eminent authority in metallurgical, chemical or kindred subjects. Mr. Wright has been a member of the Iron and Steel Institute since 1902 and has served on its council; he is also a past-president of the Cleveland Institution of Engineers. Dr. C. H. Desch, F.R.S., will deliver the first lecture on "The Past and Future of Steel" on December 13 (*see* p. 531).

Obituary

MR. WESTWOOD OLIVER MACNEILL, who died at Greenock on November 22, aged 63, was a prominent figure in the Scottish chemical trade. About 30 years ago he founded the business of Westwood Macneill & Co., Ltd., chemical and tar products merchants, of 68 Bath Street, Glasgow. He travelled extensively in the course of business, and it was during a tour of America, about 18 years ago, that he was stung by an insect at Salt Lake City; and from the effects of the illness which followed Mr. Macneill suffered until the time of his death, though his mental vigour and alertness were unimpaired

The formation of a chemical department is announced by the Quaker Oats Company, Chicago, U.S.A. The furfural and technical divisions are merged in the new department, and Dr. L. B. Hitchcock, formerly Professor of Chemical Engineering at the University of Virginia, has been appointed manager. The company has for many years been the sole U.S. producer of furfural and allied chemicals.

New Control Orders

Tartaric Acid and Cream of Tartar

The Minister of Food has made an Order, S.R. & O. 1944, No. 1279, dated November 29, revoking the Tartaric Acid and Cream of Tartar (Control and Maximum Prices) Order, 1944 (S.R. & O., 1944, No. 2). The new Order repeats the main provisions of the old Order but prescribes maximum prices on sales by first-hand distributors and distributing dealers licensed as such, and separate prices for sales by wholesalers.

Boiler Water Treatment

Draft British Standards Available

SEVERE conditions imposed by the war have caused trouble and delay, particularly to cargo steamers, owing to leaky tubes, distorted furnaces and other faults due to bad boiler feed water. Lloyd's Register of Shipping therefore requested the British Standards Institution to set up committees to explore the possibilities of preparing a standard method of chemical treatment of feed and boiler waters for marine boilers.

The researches took longer than was expected, but their results have now been embodied in a draft standard, setting out in full the treatment recommended by the committee, and three data sheets summarising, for ready reference, the three types of treatment included in the main standard. It may be mentioned that the committee was representative of some 22 organisations, including Government departments, marine institutions, shipping companies, chemical interests, and insurance companies.

The three types of treatment are:

Boiler Water Treatment Type 1, being the treatment of water in marine boilers (water-tube and Scotch) with make-up feed consisting of: (a) evaporated sea water or evaporated fresh water; or (b) unevaporated soft fresh water with total hardness less than 70 p.p.m. (5 gr. per Imperial gal.) as calcium carbonate.

Boiler Water Treatment Type 2, being the treatment of water in marine boilers (water-tube and Scotch) with make-up feed consisting of unevaporated fresh water of hardness exceeding 70 p.p.m. (5 gr. per Imperial gal.) as calcium carbonate.

Boiler Water Treatment Type 3, being the treatment of water for Scotch marine boilers with make-up feed consisting of unevaporated sea water, or in other boilers when, in emergency, the feed is contaminated by sea water to the extent that the density of the boiler water is in excess of half a thirty-second (15,000 p.p.m.).

In the main document a section is devoted to engineering factors which should be taken into consideration in correct boiler

water treatment. The circulation of a number of copies of the above document has led to such useful but voluminous comment that it will take the committee some time to review it. In the meantime copies of the draft Standard and Data Sheets may be purchased, until the final publication is available, from the British Standards Institution, 28 Victoria Street, London, S.W.1. Reference numbers and prices are as follows: CG (ME) 7186: Full Draft British Standard Methods of Treatment (to be B.S.S. 1170) and Three Data Sheets, 3s. 6d., Data Sheets separately 6d. each.

Potash Order Infringed

Liverpool Firm Fined £50

ACCUSED of having contravened the provisions of the Control of Caustic Potash and Carbonate of Potash Order by using caustic potash in the production of soft soap for non-industrial purposes without authority to do so, William Muskett Delf, trading as W. M. Delf & Co., soap manufacturers, of Rice Lane, Liverpool, was fined £10 on each of five summonses and ordered to pay £26 5s. costs, at the Liverpool Police Court, on Friday last week. The non-industrial purposes were ships' stores, shampoos and cleaning purposes

Prosecuting for the Ministry of Supply, Mr. O. C. Somerville-Jones said the offences took place between October and December, 1943. Delf had given every possible assistance to the investigation officers. The prosecution believed him when he said that he had made no gain from the contraventions. Applications for potash for soaps for export or for textile or technical soaps were granted him, but it was discovered that hairdressers had been able to obtain soft soap, made by Delf, containing caustic potash. Delf made a frank statement in which he said he was not a chemist and that he was largely in the hands of his works manager who apparently did not know what the position was. When the use of potash in the manufacture of soap was restricted, he circularised his wholesalers and advised them of the permitted uses.

The statement added: "We continued the use of potash in our soft soaps until the middle of February, 1944. The quantities we used were reduced gradually from the commencement of the restrictions as our experience enabled us to make better use of soda. . . When applying for potash from the Ministry of Supply we based our application on the estimated consumption during the ensuing three months to cover sales to all customers, the greater part of the sales being to customers for industrial purposes, small users such as hairdressers being included in the application up to December, 1943." Ships' store dealers received potash soaps until the beginning of 1944. Since then, only soda soaps had been supplied.

Mr. Delf had explained that owing to the difficulties of war-time business conditions, he had been unable to give strict attention to the regulations, so that some potash soaps had gone to users who should have had soda soaps. Counsel said he was satisfied there had been no direct financial benefit to Delf, whose concern had been to retain his clientèle. The actual consumption of caustic potash concerned in these summonses was 5 cwt. and the value about £15.

Mr. H. I. Nelson, for Delf, said the business was almost, but not entirely, concerned with technical soaps and soft soaps, used for industrial purposes. Only 5 per cent. of the business was with small people who might be called non-industrial. It was supplying small quantities of industrial soap for non-industrial purposes that gave rise to the complaint. For over two years the firm had held in store in a Lancashire town, at the request of the Ministry of Supply, a reserve quantity of solid caustic soda, and it was still there.

German Chemical Industry

Standardisation Progress

SINCE September last year a Central Standardisation Office for Chemical Products has been at work in Germany. Little has become known about its activities except that it has prepared standardisation measures in the fields of plastics, paints and photographic chemicals. New standards for plastics and paints are to be issued shortly in the form of draft instructions by the Verein Deutscher Chemiker. In future one executive body is to deal with all standardisation measures for the chemical industry. Three sections will be formed, one for general and analytical chemistry, another for chemical instruments and raw materials, and a third for chemical manufactures and finished products. The Chemical Division of the German organisation for the self-administration of industry and trade is to co-operate with the Standards Committee in the formulation of standard specifications.

Penicillin Research

The Reich Commissioner for Medical Research, Professor Dr. Rostock, presided at a conference of German research workers and representatives of chemical firms interested in the production of penicillin, which was recently held with a view to facilitating the exchange of knowledge based on experiments and experience. The conference decided to form a special committee to determine standard practices for the analysis and assay of penicillin.

The Cinemicrograph

Research Work in Industrial Chemistry

CINEMICROGRAPHY in an industrial chemical research laboratory was the subject of a recent paper presented to the Association for Scientific Photography. Mr. H. Emmett, F.R.P.S., described the set-up used in one of the I.C.I. research laboratories. A petrological microscope, above which is supported the cine camera without its lens, is used without the usual eyepiece, but it must have a viewing attachment to enable the image to be kept under observation while being filmed. Focus on the film is ensured by inserting a piece of ground glass in the gate and balancing this image with the one seen in the viewing eyepiece; careful centring of the light is of first importance. A 9.5 m.m. camera was used, connected through a belt drive to an electrically-controlled gramophone motor which enables exposures to be taken at known intervals and projected at the normal speed of 16 frames per second when slow changes can be clearly seen.

Two films were projected, the first showing very clearly a number of points of interest in the study of crystals, such as the change in crystalline form of some substances induced by the presence of impurities and the allotropic change in acicular crystals of ammonium nitrate which can take place on lowering the temperature. The second film dealt with the concentration gradient around a crystal during growth. This was shown up by having the mother liquor in a wedge-shaped cell with semi-silvered walls which produce a series of interference fringes. As the concentration in the liquor changes, the refractive index is altered and the fringes are displaced; from this the concentration gradient can be calculated.

Canadian Chemists

Progress of the New Institute

IN our editorial columns this week a note is included dealing with the formation of the Chemical Institute of Canada. News has now come to hand that the interim executive board has been getting on with its business energetically. Already a general manager and secretary has been appointed in the person of Mr. H. W. Lea, director of the Wartime Bureau of Technical Personnel to the Dominion Department of Labour. Mr. Lea is a consulting civil engineer, and has had considerable experience in the organisation of man-power both before and during the war.

Dr. H. R. L. Streight, interim director of business, reports good progress with the list he has undertaken to make of chemical personnel in Canada; the list of chairman of local membership committees is already completed. Dr. L. Lortie, interim director of professional affairs, reports, on the question of collective bargaining, that the majority of chemists and chemical engineers in Canada are opposed to the inclusion of professional workers in collective agreements as they now stand, but that they favour the existence of some form of collective negotiation. Special legislation to this end is to be proposed to the Government.

Speaking on behalf of the by-law committee, Mr. W. E. Pomeroy stated that they considered it wise to retain for the new Institute the 1921 Charter of the Canadian Institute of Chemistry, except for the change of name. Quite a wide variation in the formulation of the by-laws, however, would be required. Dr. P. E. Gagnon, honorary treasurer, had the agreeable duty of reporting the receipt of a gift to the Institute of $50 from the Kingston Chemical Association.

General News——From Week to Week

The Southwark Commercial Library, 56 Southwark Bridge Road, London, S.E.1, will be re-opening on December 11.

A new amendment list (No. 3; price 1d.) has been published for specification D.T.D. 176A: Chromium-Nickel Non-Corrodible Steel of 15 tons 0.1 per cent. proof stress.

The Ministry of Supply has decided that the selling price of lactic casein for quantities of one bag or more shall be reduced by £25 per ton as from December 1.

In the second of the series of lectures on Fuel Efficiency, now being presented at the Heriot-Watt College, Edinburgh, Dr. D. Stewart, chief chemist of Scottish Oils, Ltd., spoke on "Boiler Feed Water Treatment."

Measures of standardisation, to be devised and operated by industries themselves after the war, were advocated by Capt. Waterhouse, Parliamentary Secretary to the Board of Trade, in a speech at Hull on Tuesday.

Aluminium and magnesium are now released to manufacturers for civilian production, states the Ministry of Aircraft Production. They are also available for work on prototypes for bulk production and samples, but releases for civilian purposes are still subject to war priorities and can be authorised only through the Light Metals Control. Supplies are such, however, that there should be little difficulty in meeting reasonable requirements.

A.R.D. Electrodeposition Memorandum No. 6, entitled "Methods of obtaining adherent nickel or chromium deposits to special steel, cast iron, and non-ferrous metals," published by permission of the Director-General of Research and Development, Ministry of Supply, may be obtained on application to the Liaison Officer, Chief Superintendent of Armament Research, c/o S.T.A.M., Room 1043, Shell Mex House, Strand, W.C.2.

The Board of Trade announces that policies for fixed sums under the Commodity Insurance Scheme which are in force on December 2 will be extended until March 2, 1945, without further payment of premium. For new insurance, the rate of premium has been reduced to 2s. 6d. per cent. for the three months, minimum 5s. Policies under the Business Scheme which are in force on December 31 will be extended until March 31, 1945, without further payment. For new insurance the rate of premium for the three months will be 1s. 8d. per cent. minimum 5s.

Foreign News

From Uruguay comes the news that a committee has been set up to draft a new general customs tariff law.

In Ecuador, imports of nitrate will be subject to only 50 per cent. of the port tax of 90 sucres per metric ton gross weight.

American Home Products Corp. has acquired the Marietta Dyestuffs Co., Marietta, Ohio, which has begun production of DTD

In Cuba, distribution and consumption of ammonium sulphate for industrial or commercial use and of shellac may not be effected except under licence.

An opportunity for Latin American industrialists to provide groups of their employees with free instruction in the use of industrial precision instruments has been provided by the precision instrument department of Minneapolis-Honeywell Regulator Co.

A commission has been appointed in France to examine the transactions of the Societe d'Electrochimie and d'Electro-Metallurgie d'Ugines in Upper Savoy, accused of having delivered aluminium and special steels to the Germans, says Reuter.

The total supply of refined copper to U.S. industries in the first half of 1944 was 902,800 tons, according to WPB, Washington, and the expected total for the year is 1,750,000 tons, which may be compared with the total of 1,802,000 tons for 1943.

The current schedule of prices for cash sales of iron and steel scrap in India, issued by the Government of India (Department of Supply) on September 7 last, is published in the *Indian Trade Journal* dated September 28, 1944, p. 381.

A company for nitrogen utilisation has started production of ammonium sulphate at Sestao, Spain. Coke oven gases from the Altos Hornos de Vizcaya are being utilised.

The Kenya Government will not allow the importation of vinegar on the grounds that the vinegar industry in the colony is now able to cope with demand. It is not known whether this prohibition is merely a war-time or a permanent measure.

The advantages of air-conditioned storage for shellacs and seedlacs are demonstrated by Rangaswami and De, in Bulletin No. 56 of the Indian Lac Research Institute: "The Effect of Storage on Lac." Bulletin No. 57 deals with the properties of lac-melamine and lac-melamine-formaldehyde resins.

Forthcoming Events

The Leeds Section of the **S.C.I.** announces that the Jubilee Memorial Lecture will be given by Mr. L. A. Jordan on **December 2,** at 3 p.m., in the Lecture Theatre, Mining Department, Leeds University, on "Paint—the Art and the Science."

A short conference on "The Selection and Training of Personnel for Industry," will be held under the auspices of the London and Home Counties' branch of the **Institute of Physics,** at 2 p.m., on **December 2,** in the Royal Institution, Albemarle Street, W.1. The conference will open with an address by Major F. A. Freeth, of I.C.I., Ltd. A discussion will follow.

The **Society of Chemical Industry** meets on **December 4,** at 2.30 p.m., at Burlington House, to hear a paper by Mr. E. J. Dickinson, B.A., B.Sc., A.R.I.C., on "The Constitution of Road Tar." (Joint meeting with the Road and Building Materials Group.)

The next meeting of the Midlands Centre of the **Electrodepositors' Technical Society** will take place at the James Watt Memorial Institute, Great Charles Street, Birmingham, 3, on **December 5,** at 6 p.m., when a paper on "Pressing Technique as a Preliminary to the Production of Good Electrodeposits," will be presented by J. D. Jevons, Ph.D., A.R.I.C.

An address entitled "Thirty Years of Industrial Chemistry, 1914-1944," will be given by Mr. J. W. Parkes on **December 6,** at 7.30 p.m., in University College, Upper Merrion Street, Dublin, before the **Royal Institute of Chemistry,** Dublin section.

"Petroleum Production in England," is the title of a lecture to be delivered by C. A. P. Southwell, M.C., B.Sc., F. Inst. Pet. (of the Anglo-Iranian Oil Co., Ltd.) on **December 6,** at 2.30 p.m., before the **Royal Society of Arts,** at the Institution of Mechanical Engineers, Storey's Gate, S.W.1.

The **Food Group,** S.C.I., jointly with the

Society of Public Analysts and other analytical chemists devote a meeting on **December 6,** at 2.30 p.m., at Burlington House, to the subject of "Methods of Sampling Foods in Bulk." Papers will be presented by J. King on "Some Experiences in the Sampling of Foods in Bulk," by C. A. Mawson on "Sampling of Cooked Meals for Nutritional Analysis" and by E. M. Widdowson on "Samplings for Metabolism Studies."

The **Chemical Engineering Group,** the **Institution of Chemical Engineers** and the Bristol Section **S.C.I.** are holding a joint meeting on **December 7,** at 5.30 p.m., in the University Chemical Department, Woodland Road, Bristol, when a paper on "Iron Exchangers Applied to Water Treatment," will be presented by Mr. R. T. Pemberton, M.I.Chem.E.

A meeting of the three chartered bodies will take place on **December 8,** at 7.30 p.m., at the North British Station Hotel, Edinburgh. Prof. Alexander Findlay, President of the Royal Institute of Chemistry, will speak on "Pioneers of Physical Chemistry."

The **Royal Institute of Chemistry** (Teesside Section), jointly with the Newcastle Branch of the **Society of Chemical Industry,** arrange a meeting on **December 9,** at 3 p.m., at Norton Hall, Stockton-on-Tees. Mr. E. J. Bowen will lecture on "Chemical Links—A Story of Wave Mechanics."

The **Chemical Engineering Group (S.C.I.),** and the **Institution of Chemical Engineers,** meet on **December 12,** at 2.30 p.m., in the Geological Society, Burlington House, W.1, to hear a paper on "Forestry, and the Utilisation of Waste Food and its Products as Fuel," by Mr. N. Clarke Jones, A.M.I.Chem.E.

Dr. C. H. Desch, F.R.S., will deliver the first **Harold Wright Lecture** on "The Past and Future of Steel," on **December 13,** at 7.15 p.m., in the Cleveland Scientific and Technical Institute, Middlesbrough.

Mr. E. J. Heely will present a paper on "Some Considerations in the Design of Class I Pressure Vessels," at **The Institution of Mechanical Engineers,** Storey's Gate, S.W.1, on **December 15,** at 5.30 p.m.

The annual general meeting of the **British Association of Chemists** will take place at York, on **December 16.**

Company News

The Allied Chemical Company is paying a regular quarterly dividend of $1.50 per share.

The Anglo Iranian Oil Co., Ltd., announces an unchanged interim dividend of 5 per cent.

A. Boake, Roberts & Co., Ltd., have declared a second interim dividend of 1½ per cent. (same).

Chloride Electrical Storage Company, Ltd., has declared an interim dividend of 5 per cent. (same).

Bell Brothers (Manchester, 1927), Ltd.—Trading profit to March 31, £18,639 (£25,898); net profit, £7619 (£8739).

Venezuelan Oil Concessions, Ltd., are paying an interim dividend of 5⅝ per cent. (5 per cent.).

Birmid Industries, Ltd., announce a dividend of 10 per cent. (same), plus a cash bonus of 10 per cent. (7½ per cent.) for the year ended October 31.

The Imperial Smelting Corporation, Ltd., announces a net profit, for the year ended June 30, of £119,524 (£119,167). The dividend is 4 per cent. (same).

An extra dividend of 50 cents. per common share has been declared by **Shell Union,** bringing the total for 1944 to $1.50 ($1.25).

Major & Co., Ltd., record a trading profit, to March 31, of £8547 (£10,698). There is no final dividend, but an interim of 6 per cent. (same) on both classes of shares has already been paid.

British Benzol & Coal Distillation, Ltd., recommend a final dividend of 5 per cent., and a bonus of 5 per cent. (both unchanged). Thus the distribution for the year to October 31, 1944, is held at 15 per cent. The year's net profit is £29,514 (£28,361).

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

BRITISH CELANESE, LTD., Torquay. (M., 2/12/44.) November 8, deed supplemental to a Trust Deed dated September 20, 1943; charged on certain land and buildings at Spondon; also November 8, deed supplemental to a Trust Deed dated May 1, 1941; charged on certain land and buildings at Spondon (subject to deed dated September 20, 1943). *£3,122,761. January 4, 1944.

PARK ROYAL SCIENTIFIC INSTRUMENTS, LTD., London, W.C. (M., 2/12/44.) November 3, £1500 debentures; general charge.

BRITISH INDESTRUCTO GLASS, LTD., London, N.W. (M., 2/12/44.) November 9, deed of charge and variation, supplemental to a debenture dated April 22, 1943, to Martins Bank, Ltd.; charged on movable plant, machinery, fixtures, etc. *£12,375. December 31, 1943.

New Companies Registered

Alexander Rush, Ltd. (391,225).—Private company. Capital, £1000 in 1000 £1 shares. Manufacturers of and dealers in drugs, chemicals, disinfectants, colouring materials, etc. Directors: E. A. Rush (director of National Colours, Ltd.); Sarah Rush. Registered office: Progress Works, Hempshaw Brook, Stockport, Cheshire.

Plastanol, Ltd., (391,355).—Private company Capital £1000 in £1 shares. Manufacturers of and dealers in synthetic and natural resins, products and components of plastics, oils, solvents, paints, polishes, chemicals, etc. Subscribers: L. W. Law, C.A., 6 Bisterne Avenue, E.17; R. A. V. Billing.

New Metals and Chemicals, Ltd. (391,242).—Private company. Capital, £10,000 in 5000 "A" and 5000 "B" shares of £1 each. Dealers in and manufacturers and refiners of metals, metal alloys and salts, minerals and chemicals, etc. Directors: G. H. Owtram, H. Fleischmann, E. D. Wainwright, Capt. M. J. N. Waters. Registered office: 53 Broad Street Avenue, E.C.2.

Anthony M. Sheridan and Co., Ltd. (391,136).—Private company. Capital, £1000 in 1000 £1 shares. Chemists and druggists, chemical engineers, laboratory proprietors, manufacturers of and dealers in cosmetics, dyes, ointments, etc. Directors: A. M. Sheridan (formerly "Schneider"), C. H. Sheridan (formerly "Schneider"). Registered office: Devonshire Chambers, 146 Bishopsgate, London, E.C.2.

Chemical and Allied Stocks and Shares

ALTHOUGH business in stock markets has been limited, the tone continued firm, sentiment reflecting the war news and the renewed rise in British Funds. Leading industrials were steady, with Imperial Chemical 39s. 7½d., Dunlop Rubber 46s. 6d., Lever & Unilever 46s., and British Match 42s. 3d. Awaiting the financial results, Turner & Newall were 83s. British Aluminium were 46s. 3d., and British Oxygen 89s., while, pending the interim dividend, Metal Box shares were 93s. 1½d. Associated Cement rallied slightly to 60s. 6d., and British Plaster Board continued active around 40s. 3d. xd., a higher final dividend being generally expected in the market despite the absence of an increase in the interim.

Activity continued in British Celanese, awaiting the results, but at 31s. 9d. part of the earlier rise was lost. Courtaulds were steady at 55s. 9d. Iron and steels continued firm, Allied Ironfounders strengthening to 53s. 9d., and Babcock & Wilcox to 52s. 9d., with Staveley 52s. 6d., Ruston & Hornsby 50s., Consett Iron 8s. 1½d., and Dorman Long 27s. 6d. Richard Thomas at 13s. 7½d., and Baldwins at 7s. had a steadier appearance, full details of the proposed merger being expected shortly. Stewarts & Lloyds were 56s. 3d., and Tube Investments 100s. 7½d. Full results of the last-named company are imminent. A good feature was provided by an advance of 7s. 6d. to 87s. 6d. xd in Birmid Industries, following the raising of the distribution from 17½ to 20 per cent. Proposed further large expenditure on grid extensions drew attention to shares of electrical equipment companies, General Electric being 96s. 3d., Associated Electrical 56s. 9d., English Electric also moving up to 54s. 3d., and Crompton Parkinson to 33s. 9d. Dividend announcement of the last-named company is impending.

Reflecting disappointment of market hopes of a dividend increase, Imperial Smelting were 14s. 4½d. Elsewhere, Borax Consolidated eased to 37s. 6d. General Refractories 10s. shares were 17s. 10½d. Triplex Glass strengthened to 42s. 9d. after an earlier decline, as did Radiations at 58s. 9d. Anglo-American Asphalt shares were firm at 40s. 6d., International Paint 116s. 3d., and Lewis Berger 105s. 6d., with Barry & Staines 52s. 3d., and Nairn & Greenwich at 76s. 10½d. firmly held. The dividend announcement of the latter company is due in a few weeks. The units of the Distillers were 107s. 6d., and United Molasses 6s. 8d. units 37s. 10½d. Among shares of companies connected with plastics, De La Rue were 193s. 9d., Erinoid 5s. ordinary 11s. 6d., British Industrial Plastics 7s. 1½d., and Lacrinoid Products 2s. shares 5s. 4½d.

B. Laporte were 82s., W. J. Bush again quoted at 70s., British Drug Houses 28s., Burt Boulton 24s., and Cellon 5s. ordinary 24s. 6d. Greeff-Chemicals 5s. ordinary remained at 8s., and Monsanto Chemicals 5½ per cent. preference at 23s. Morgan Crucible second preference marked 24s. 9d., and elsewhere, William Blythe 3s. shares remained at 9s. There was rather more speculative activity in German Potash bonds, the 7 per cent. improving to 48s. and the 6½ per cent. to 47s. Low Temperature Carbonisation 2s. ordinary were dealt in up to 2s. 7½d. Gas Light & Coke ordinary kept steady at 23s. Boots Drug showed steadiness at 56s. 6d., with Sangers 29s., Timothy Whites 40s. 6d., and Beechams deferred 19s. 9d. Oil shares were easier, Anglo-Iranian easing further to 113s. 7½d., and

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Burmah Oil to 86s. 3d. British Controlled Oil issues were more active on talk that the promised capital scheme may be imminent.

British Chemical Prices

Market Reports

SATISFACTORY trading conditions have been reported from most sections of the London general chemicals market this week and a moderate increase in new business is reported. With regard to deliveries against contracts, the movement is steady and, in the aggregate, fairly substantial. The price position remains firm throughout the market. In the soda products section the demand for caustic soda has been steady and acetate of soda is a good market. Yellow prussiate of soda is firm with supplies scarce, while inquiry for soda ash and bicarbonate of soda is maintained, and the photographic and technical grades of hyposulphite of soda are meeting with a steady request. Both Glauber salt and salt cake are in brisk demand, chiefly against contracts, and a fair trade is passing in the diphosphate and triphosphate of soda at recent levels. In the potash section, the shortage of caustic liquor continues, and prices are largely nominal. British-made permanganate of potash is in good demand, with values well held, while bichromate of potash and yellow prussiate of potash remain scarce. In other directions, powdered arsenic, sulphur, and calcium carbide are meeting with a persistent inquiry and offers are finding a good outlet at firm prices. Hydrogen peroxide is a good market. Acetone is in steady demand and supplies of alum lump are moving steadily. Quiet trading conditions continue to prevail in the market for coal-tar products.

MANCHESTER.—Fresh inquiries on the Manchester chemical market during the past week have resulted in no more than moderate additions to order-books in most lines, but the majority of the chemical-using trades in Lancashire and the West Riding of Yorkshire are maintaining a steady rate of operations. This is reflected in the demand for the alkalis and many other descriptions, including carbonate and bicarbonate of ammonia, the potash chemicals generally, which remain in short supply, and hydrochloric and most other acids. Most classes of fertilisers continue to move steadily into consumption. Among the heavy tar products, crude tar and creosote oil are in steady demand, while among the lighter classes the toluols and benzols are about the most active, with moderate new buying interest being displayed in the xylols.

GLASGOW.—In the Scottish heavy chemical trade business has been rather moderate during the past week in the home market. Export inquiries remain rather limited. Prices keep very firm.

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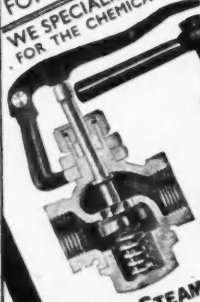
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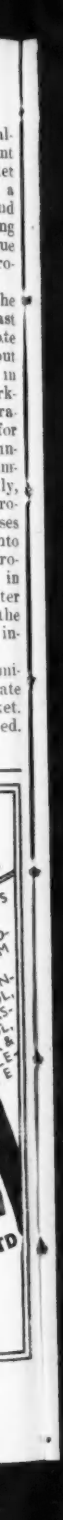

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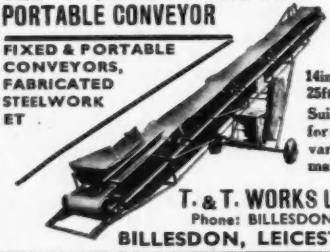

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